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Lactarius rupestris—a new species from the Brazilian semi-arid region

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Abstract — *Lactarius rupestris* is proposed as a new species from the Brazilian semi-arid region. It is characterized by the rather stout basidiome with a ochraceous salmon stipe that is up to 21 mm wide, a relatively smooth and viscid orange tinted pileus, close and frequently anastomosed lamellae, subglobose to ellipsoid basidiospores with distinct verrucae up to 0.7 µm high, a trichoderm pileipellis, and abundant sphaerocysts in the lamellar and pileus tramas.

Key words — *Agaricomycetes*, *Russulales*, neotropics, taxonomy

Introduction

The globally distributed genus *Lactarius* Pers., which with *Russula* Pers. forms the core of the family *Russulaceae,* is one of the major groups of ectomycorrhizal macrofungi. It can be identified by the basidioma exuding latex (Singer 1986) and the presence of common pseudocystidia (Miller et al. 2006).

In Brazil at least 19 taxa of *Lactarius* are known: *L. amazonensis* Singer, *L. annulifer* Singer, *L. campinensis* Singer, *L. gigasporus* Singer, *L. igapoensis* Singer, *L. mamorensis* Singer, *L. pallidipes* Singer, *L. reticulatus* (Berk.) Singer, *L. subpallidipes* Singer and *L. subreticulatus* Singer in Amazonian lowland forests (Pegler & Fiard 1979, Singer et al. 1983, Pegler 1988, Souza & Aguiar 2004); *L. deliciosus* (L.) Gray, *L. rufus* (Scop.) Fr. (these from exotic *Pinus* plantations) and *L. venezuelanus* Dennis from Paraná (Buyck & de Meijer 1999; de Meijer 2001, 2006); *L. deliciosus*, *L. rufus* and *L. russula* Rick from Rio Grande do Sul (Singer 1953, Guerrero & Homrich 1983, Singer et al. 1983, Sobestiansky 2005); *L. argillaceifolius* Hesler & A.H. Sm. var. *argillaceifolius*, *L. deliciosus*, *L. fragilis* (Burl.) Hesler & A.H. Sm. var. *fragilis*, *L. rufus* var. *parvus* Hesler & A.H. Sm. and *L. rufus* var. *rufus* in exotic *Pinus* plantation from Santa Catarina (Giachini et al. 2000, Karstedt & Stürmer as *L.* cf. *fragilis*); *L. hygrophoroides* Berk. & M.A. Curtis and *L. paulensis* Singer from São Paulo (Singer et al. 1983, Pegler 1997).

Here we describe a new species of *Lactarius* from the Brazilian semi-arid region, collected in the National Park of Catimbau, located in the ecoregion of the caatinga biome called "Planalto da Borborema" (Velloso et al. 2002) in an area characterized as "campo rupestre," which commonly occurs at 900-1000 m alt. (Rodal et al. 1998). In this area, members of *Apocynaceae*, *Bignoniaceae*, *Erythroxylaceae*, *Euphorbiaceae*, *Lauraceae*, *Fabaceae*, *Malpighiaceae*, *Myrtaceae*, *Polygonaceae*, *Rubiaceae*, *Sapindaceae*, *Simaroubaceae*, *Solanaceae*, *Trigoniaceae*, *Turneraceae,* and *Verbenaceae* are commonly found (Rodal et al. 1998, Andrade et al. 2004, Gomes et al. 2006).

Materials and methods

For microscopic analyses 3% KOH and Melzer's reagent were used and terminology for microstructures follows Verbeken (1998a). Colors of basidiomes were observed in fresh material, and color coding follows Online Auction Color (2004). Presentation of basidiospore data follows the methodology proposed by Tulloss et al. (1992) where the notation "[*a*/*b*/*c*]" at the beginning of the spore data set is to be read "*a* spores measured from *b* basidiomes taken from *c* collections." Other abbreviations include **L(W)** = basidiospore length (width) average from a single basidiome, Q = the length : width ratio range as determined from all measured basidiospores, and **Q** = the Q value averaged from all basidiospores measured within a single basidiome. The holotype of *L. rupestris* is deposited in the Herbarium of the Mycology Department of the "Universidade Federal de Pernambuco" (URM).

Taxonomy

Lactarius rupestris Wartchow, **sp. nov.** Fig. 1–5

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Pileus 60–70 mm, concavus-subinfundibuliformis, depressus, margine regulari, subviscosus, brunneo-aurantius ad flavidum in margine. Lamellae subdecurrentes, confertae, ochraceae, salmonescentes. Stipes 35–45 × 18–21 mm, subcylindratus, pallide ochraceus salmonescens. Latex cremeous, haud abundantibus. Basidiosporae (6.5–)7–8.5(–9) × (5.5–)6–7(–7.5) µm late ellipsoideae, subreticulatae, cristis usque ad 0.3–0.7 µm altis ornatae, macula suprahilaris non amyloidea. Basidia 35–50 × 8–11 µm, clavata, tetraspora. Pleurocystidia absentia. Pleuropseudocystidia rara. Pileipellis trichoderma, cellulae terminales 20–51 × 4–6 µm, subfusiformes, clavatae vel subcylindricae, tenuitunicatae; subpellis hyphis angustis.

Type: Catimbau National Park ("Trilha do Camelo"), Buíque, Pernambuco, Brazil, 23 July 2007 **Holotype:** F. Wartchow 15/2007 (URM 80214), preserved in a phormol-acetic acid-alcohol solution.

Pileus 60–70 mm, concave-subinfundibuliform, somewhat umbilicate, orange (OAC 763) at center to brownish orange towards margin (OAC 694, OAC 715), moderately viscid, smooth to somewhat cracking, very indistinctly tomentose; margin entire, not striate neither sulcate, slightly involute. Lamellae short decurrent, cream-salmon (OAC 766–767), crowded to most frequently sub-

crowded, up to 3 mm broad, frequently dichotomously branching in several lengths; margin smooth, concolorous; lamellulae frequent, with diverse lengths. Stipe 35–45 × 18–21 mm, central, cylindrical, slightly tapering near the base, pale ochraceous salmon (OAC 763), with short decurrent lines at upper surface near to lamellae attachment, longitudinally slightly ribbed (only under lens). Context spongy, pale yellow ochraceous (OAC 793–794) in pileus, cream yellow (OAC 793) in stipe. Latex cream-colored to more or less concolorous with lamellae, not abundant.

Basidiospores [25/1/1] (6.5–)7–8.5(–9) × (5.5–)6–7(–7.5) µm (**L** = 7.8 µm, **W** = 6.3 µm, Q = (1.13–)1.16–1.34(–1.39), **Q** = 1.24), broadly ellipsoid to ellipsoid, occasionally subglobose; ornamentation amyloid, finely verrucose with each wart ranging to 0.5–0.7 µm high, interconnected by fine line, but never forming a complete reticulum; hilar appendix narrowly obtuse to subconical to conical; plage not very distinct, but with amyloid spot. Basidia 35–50 × 8–11 µm, clavate, bearing mainly four, but sometimes two very long (6–10 µm long) sterigmata. Pseudopleurocystidia very scarce, 170 × 24 µm long, with brownish refractive contents, thin-wall, arising from deep in the hymenophoral trama. Lamella edge sterile, with marginal cells 30–45 × 4–6 µm, cylindrical somewhat sinuous, thin-walled, hyaline. Pileus context with abundant sphaerocysts 25–65 × 24–50 µm, globose or nearly so; filamentous hyphae up to 10 µm wide; lactiferous hyphae common, up to 15 µm broad, with a longitudinal orientation, somewhat diverging from trama, but not forming projecting pseudocystidia. Subhymenium with clavate, inflated clavate to nearly subglobose cells 16–27 × 9–17 µm. Hymenophoral trama heteromerous, with abundant nearly isodiametric (17–25 × 13–18 µm) cells, filamentous hyphae 3.5–6.5 µm; lactiferous hyphae frequent, up to 7–12 µm broad, straight and only occasionally branching. Pileipellis a trichoderm up to 140 µm thick, two layered; elements of suprapellis 20–51 × 4–6 µm, plentiful, colorless, thin-walled somewhat thickening up to 0.5 µm, obtuse, subacute to infrequently subcapitate or pyriform; subpellis composed of plentiful hyphae of 3–8 µm wide and somewhat more inflated cells to 10–18 µm wide, colorless. Clamp-connections absent in all tissues examined.

Habitat: buried with up to 2/3 of the stipe in sandy soil near several shrubs (*Fabaceae* subfam. *Mimosoideae* and others) in a semi-arid region, after heavy precipitation.

Distribution: Known only from the type locality.

Remarks: *Lactarius rupestris* is characterized by the rather stout basidiome with an ochraceous salmon stipe that is up to 21 mm wide, a relatively smooth pileus with orange tints when fresh, close and frequently anastomosed lamellae,

broadly ellipsoid to ellipsoid basidiospores that are distinctly verrucose with ornamentation up to 0.7 µm high, a trichodermial pileipellis with a suprapellis of erect thin-walled elements, and a cellular pileus trama. Its presence in the Brazilian semi-arid makes it unique among the *Lactarii*.

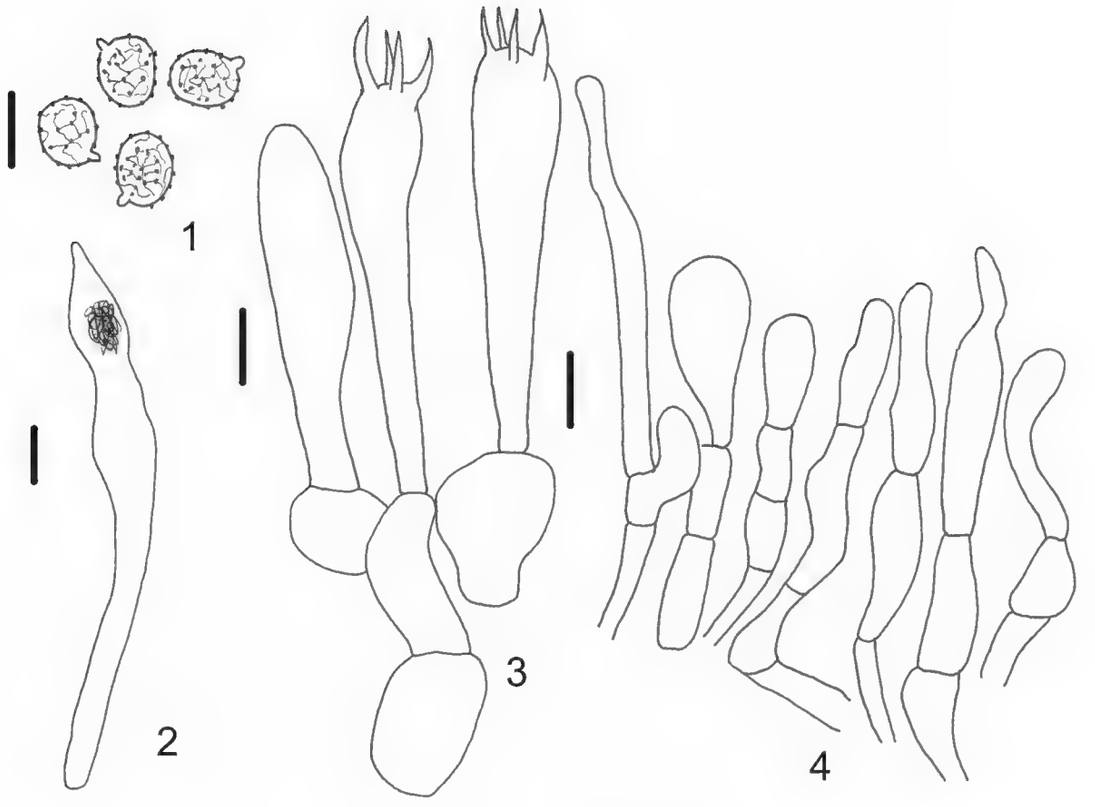
According to the key in Verbeken (2001), the lack of annulus, unchanging context, relatively smooth (neither pruinose nor truly tomentose) pileus, pale basidiospores with interconnected low spines, non-zonate pileus, entire lamellar edge, stout basidioma, non-palisade type pileipellis structure, and absence of thick-walled dermatolamprocystidia support placement of *L. rupestris* into *Lactarius* sect. *Edules* Verbeken. However, the frequently aerolate, relatively dry pileus surface and less ornamented basidiospores cited in the protologue for sect. *Edules* by Verbeken & Walleyn (1999) does not fit our new species. This section remains unclassified at the subgenus level, and Verbeken & Walleyn (1999) and Buyck et al. (2007) report that it would probably be elevated to subgenus after more research on a global scale (Buyck et al. 2007).

Verbeken (2001) includes at least six tropical African species in this section, among which four also have the crowded lamellae and somewhat similar basidiospore size found in *L. rupestris*: *Lactarius densifolius* Verbeken & Karhula, *L. inversus* Gooss.-Font. & R. Heim, *L. phlebophyllus* R. Heim, and *L. nodosicystidiosus* Verbeken & Buyck. All four differ from *L. rupestris* in their lower basidiospore ornamentation and dry cracking aerolate pileus, distinctive features of these African taxa (Verbeken & Walleyn 1999, Buyck et al. 2007).

In the Verbeken (2001) key, *Lactarius* sect. *Chamaeleontini* Verbeken, characterized by a smooth pileus, contains one species, *L. laevigatus* Verbeken, with a trichoderm pileipellis without thick-walled elements, features that differ from the rest of this section (Verbeken 1998b). However, the strongly striate, deeply sulcate pileus margin that characterizes this section (Verbeken 1998b) is lacking in *L. rupestris;* furthermore, the ornamentation of *L. laevigatus* basidiospores does not exceed 0.2 mm (Verbeken 1996).

We regard *L. rupestris* as a rather isolated species that does not fit entirely into any tropical infrageneric taxon proposed by Verbeken (2001). Its slightly moist, non-aerolate pileus and relatively high basidiospore ornamentation separate our new species from *L.* sect. *Edules* as well as from *L. laevigatus* of sect. *Chamaeleontini*.

Different infrageneric arrangements exist for *Lactarius* outside the sections discussed above (Verbeken 1998b, 2001). The occurrence of abundant subisodiametric to sphaerocystidioid cells in the lamellar trama of *Lactarius rupestris* also characterizes *L.* sect. *Polisphaerophori* Singer. Montoya et al. (2007), however, recently transferred the type species of the section — *L. verae-crucis* Singer (Pegler & Fiard 1979, Singer et al. 1983, Singer 1986) — to



Figs. 1–4. *Lactarius rupestris* (from holotype).
1. Basidiospores. 2. Pleuropseudocystidium. 3. Basidia, basidiole and subhymenium.
4. Terminal elements of the pileipellis.
Scale bar = 10 µm (Figs. 1,3,4) & 20 µm (Fig. 2)

Fig. 5. *Lactarius rupestris* (from holotype). Basidiomes.
Photo by E.R. Drechsler-Santos.

subgenus *Lactiflui* (Burl.) Hesler & A.H. Sm. emend Verbeken based on similar basidiome color, distant lamellae, basidiospore morphology, and possession of a pseudoparenchymatous pileipellis with thick-walled lamprocystidia shared with *L. luteopus* Verbeken.

A previous comparison of a Brazilian collection with the holotype of *L. venezuelanus* (a species from Venezuela also classified in *Polisphaerophori* by Pegler & Fiard, 1979), showed that *L. venezuelanus* should be referred to subgenus *Lactariopsis* (Henn.) R. Heim sect. *Chamaeleontini* (Buyck & de Meijer 1999) due to presence of thick-walled lamprocystidia and the well developed underlying pseudoparenchymatous layer and the absence of veil and macrocystidia. Such analyses suggest that sect. *Polisphaerophori* is rather artificial, and detailed morphological and molecular analyses are needed before classifying new world taxa at an infrageneric level.

Lactarius rupestris differs from the other taxa in sect. *Polisphaerophori* with a brightly colored (but not yellow) pileus and distinctly pigmented stipe covered by Singer et al.'s (1983: 294) key as follows:

The Amazonian *L. mamorensis* is differentiated by a conspicuously ribbed and slender (≤ 13 mm diam) stipe, with each rib somewhat anastomosing, a mature pileus that is tuberculate-sulcate or transparently striate, and a pileipellis composed of upright chains of 2–4 sphaerocysts forming a short epithelium at the base of the thin walled dermatocystidia (Singer et al. 1983).

Lactarius paulensis, from the State of São Paulo, differs from *L. rupestris* in the much more slender (≤ 8 mm diam) stipe, short-sulcate pileus margin, reddish brown to brownish cinnamon pileus color, and larger (8.5–10 × 7–9 µm) basidiospores (Singer et al. 1983). The pileipellis of this species was described as having erect dermatocystidioid elements with thin or slightly thickened (to 1 µm) walls that arise from a subpellis consisting of a shallow and often discontinuous layer of sphaerocysts and more elongated elements, and some crenate in outline (Singer et al. 1983). These cells might be interpreted as a trichopalisade pileipellis, on which a distinct layer is never formed, with generally ascending, anticlinal elements that are inflated or almost rounded and terminal elements that arise from these elements (Verbeken 1998a).

Lactarius rupestris was collected with more than 2/3 of its stipe buried in the sandy soil in "campos rupestres". A similar pattern was recently observed with *Amanita lippiae* Wartchow & Tulloss also collected from this forest vegetation type where one of the basidiomes was completely hypogeous (Wartchow et al. 2009).

Other Brazilian *Lactarius* species are known from campina, campinarana, and periodically inundated Igapó forests from Amazonas, North Brazil, where the plants (mostly shrubs) are adapted to sandy nutrient-poor soils (Singer

& Araújo 1979, Singer et al. 1983, Singer & Aguiar 1986). Lleras & Kirkbride (1978) named this type of forest the "Amazonian caatinga".

The "campos rupestres" are open, dry forests that occur commonly at 900–1000 m alt. (Rodal et al. 1998). Actually, *L. rupestris* is not the only species restricted to dry open forests. Verbeken & Buyck (2002) observed a relatively high phytogeographical and ecological specificity for several taxa (mainly *Lactarius*) of ectomycorrhizal fungi that are found in open (miombo, *Uapaca* woodland) or dense forest types (e.g., rain-, riparian, gallery swamp, dry evergreen forest). Pegler & Fiard (1979) concluded that in the Lesser Antilles *Lactarius* is largely restricted to dry and semi dry forests accompanying putative ectotrophic forest trees [e.g., *Pisonia fragrans* (*Nyctaginaceae*), *Coccoloba diversifolia* (*Polygonaceae*)].

The "campos rupestres" where *Lactarius rupestris* was collected also contains members of putative ectomycorrhizal tree families (sensu Singer & Araújo 1979, Singer et al. 1983), such as *Euphorbiaceae*, *Fabaceae* (all three subfamilies), *Myrtaceae*, *Nyctaginaceae,* and *Polygonaceae* (Rodal et al. 1998, Andrade et al. 2004, Gomes et al. 2006). Due to this high plant diversity, it is difficult to identify for certain the putative mycorrhizal associate of *L. rupestris,* and so it becomes necessary to record all potential hosts within a 20 m radius. Taylor & Alexander (2005) note that it is virtually impossible to identify a host solely based on where the basidiome is collected and that choosing the nearest tree species as the host could be very misleading.

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